

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH62640
	REVISION Final Rev1
SUBJECT: INSTRUMENT OPERATION <i>Alnor® 6000-P Velometer Operation</i>	DATE 10/31/05
	PAGE 1 OF 12

Contents

- 1.0 Purpose/Scope**
- 2.0 Responsibilities**
- 3.0 Definitions**
- 4.0 Prerequisites**
- 5.0 Precautions**
- 6.0 Procedure**
- 7.0 Implementation and Training**
- 8.0 References**
- 9.0 Attachments**
- 10.0 Documentation**



1.0 Purpose/Scope

The purpose of this document is to provide a standardized field procedure for operating the *Alnor® Velometer*. This document shows how to use the meter for collecting air velocity and duct static pressure data. The procedure for operating the *Alnor® Velometer* is based on information provided in the operating instructions manual.

The data collected with this meter may be used to determine acceptable airflow and duct pressure measurements for chemical hoods as well as local exhaust ventilation and HVAC systems. The unit is an analog meter and has no data logging capabilities. For specific tasks and use of the meter in ventilation measurements, refer to the SOPs IH62series on system evaluation and validation.

2.0 Responsibilities

- 2.1 This procedure will be implemented through the SHSD Industrial Hygiene Group Leader. The IH Group Leader may assign the duties to an *Exhaust Ventilation Program Administrator*. Members of the SHSD Industrial Hygiene Group, the Radiation Control Division Facility Support Group, and Plant Engineering can qualify to perform tasks in

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH62640
	REVISION Final Rev1
SUBJECT: INSTRUMENT OPERATION	DATE 10/31/05
<i>Alnor[®] 6000-P Velometer Operation</i>	PAGE 2 OF 12

this program based on their approval by their line management. Personnel who have demonstrated competency in performing tasks, in accordance with this procedure, will be qualified to serve as Qualified Sampler. Qualification is documented in Attachment 9.3.

- 2.2 Data Quality Control procedures: The Qualified Sampler is responsible for the integrity of the data and proper transfer to the IH Group database.
- 2.3 Hazard Analysis of the Sampling Task: It is the responsibility of the Qualified Sampler and his/her supervisor to ensure that training is current and the appropriate personal protective equipment is worn. In addition, the person performing this procedure and his/her supervisor are responsible to ensure that all required training and qualification for other hazards that may be present in areas (such as respiratory protection or radiation contamination) have been met. The Qualified Sampler and their line supervisor are responsible to comply with all work planning and work permit system requirements.
- 2.4 The Qualified Sampler is required to request and check the instrument in and out of the IH lab in accordance with the SOP's IH51200 & IH51500.

3.0 Definitions:

Program Administrator: A person designated by the IH Group Leader or SHSD management to administer this procedure and the associated program of toxic exhaust ventilation.

Qualified Sampler: A person who has demonstrated competency in accordance with Section 7 to perform the proper use of this instrument.

Pitot Probe: a general purpose measuring probe suitable for velocity measurements at supply openings, return openings and within ducts. The principle is to measure differential pressures and use these to calculate the air velocity.

Low Flow Probe: Attached directly to the meter body this probe is intended to measure velocity ranges of 30-300 feet per minute (fpm). This is particularly suited for: drafts in rooms or open spaces; ventilating hood/spray booth face velocity; and similar applications.

<p align="center">BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division</p> <p align="center">INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure</p>	<p>NUMBER IH62640</p>
	<p>REVISION Final Rev1</p>
<p>SUBJECT: INSTRUMENT OPERATION</p>	<p>DATE 10/31/05</p>
<p><i>Alnor[®] 6000-P Velometer Operation</i></p>	<p>PAGE 3 OF 12</p>

Diffuser Probe: This probe is designed to measure the output of HVAC supply/return diffusers. A manufacturer's "K" factor is required for each type of diffuser tested.

Static Pressure Probe: This probe measures static pressure of a duct by securely placing over a one-quarter inch hole drilled in the side of the duct. There are two static pressure probes. The first measures up to 1" wg. The second measures up to 10" wg.

Range Selector: Two range selectors are available for the *Alnor[®] Velometer*. The first selector may be switched for ranges 0-1,250 and 0-2,500 fpm. The second selector may be switched for ranges 0-5,000 and 0-10,000 fpm. These scales are directly read from the meter body.

K Factor: Each manufacturer of supply/return diffusers for HVAC systems develops this factor for adjustments to air velocity readings to calculate flow rates.

Temperature/Pressure Corrections: Changes in atmospheric pressure have a small effect on velometer indications. Corrections for static pressure in a duct are too small to be considered. When velocity measurements have to be made accurately at conditions where a temperature differential exists, such as in measuring velocities inside hot air ducts, the Velometer reading correction can be made utilizing the following equation.

$$V_c = V_m \sqrt{((t_o + t_m)/t_{std})}, \text{ where}$$

V_c	= Corrected Velocity	fpm
V_m	= Measured Velocity	fpm
t_m	= Temperature of test air/gas	°F
t_o	= Absolute zero temperature differential	460 °F
t_{std}	= Standard temperature	530 °F

4.0 Prerequisites

Training: For SHSD personnel, the SHSD Industrial Hygiene Group Leader, Program Administrator or their designee, will qualify personnel in the use and interpretation of results from the *Alnor[®] Velometer* using Attachment 9.3.

5.0 Precautions

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH62640
	REVISION Final Rev1
SUBJECT: INSTRUMENT OPERATION <i>Alnor® 6000-P Velometer Operation</i>	DATE 10/31/05
	PAGE 4 OF 12

5.1 Hazard Determination:

- 5.1.1 This meter may be used in areas where chemical contamination may be present. These contaminants can have significant health effects and must receive a hazard evaluation by a cognizant ESH professional. This meter does not generate a hazard to the operator or occupants.
- 5.1.2 Smoke generating devices (eg. candles, matches, etc.) may be used in conjunction with this meter for visual observation of air flow patterns. Although the smoke is hazardous it is typically used in small quantities and controlled by the ventilation system being tested.
- 5.1.3 Using this procedure does not generate Hazardous Wastes or have negative environmental consequences.
- 5.1.4 The test equipment design does not cause significant ergonomic concerns in routine use. The meter does not have a noise hazard.

5.2 Personal Protective Equipment

- 5.2.1 Typically, this meter is primarily used for measuring air flow velocity and duct pressure measurements where there is some risk to the sampler from hazardous chemicals or radiological contamination. Personal Protective Equipment may be needed as appropriate to the task.
- 5.2.2 The use of smoke generating devices will require eye protection.

6. Procedure

6.2. Equipment: (see Attachment 9.1)

- 6.2.1. *Alnor® Velometer* meter.
- 6.2.2. Measuring Probes (4):Lo-Flo; Pitot; Diffuser; Static Pressure
- 6.2.3. Range Selectors: (2)
- 6.2.4. Connecting Hoses (2)
- 6.2.5. Range Selector Filters
- 6.2.6. A source of smoke may be required for use with this equipment for visual observation of air flow patterns.

6.3. Inspect the meter and accessories

- 6.3.1. Visually inspect the meter to ensure all parts are working and undamaged. There are no batteries with this unit. There is no manufacturer's recommended calibration for this unit.
- 6.3.2. Check the hoses for cracks and leaks.

<p align="center">BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division</p> <p align="center">INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure</p>	<p>NUMBER IH62640</p>
	<p>REVISION Final Rev1</p>
<p>SUBJECT: INSTRUMENT OPERATION</p>	<p>DATE 10/31/05</p>
<p><i>Alnor® 6000-P Velometer Operation</i></p>	<p>PAGE 5 OF 12</p>

6.4. Using the Probes

- 6.4.1. Probe selection is based on the task to be conducted and the range of expected values. There are four (4) probes and two range selectors provided with the kit.



6.5. Units of Measurement

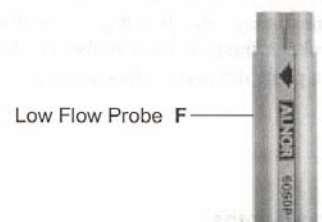
- 6.5.1. The unit is set to read in feet per minute for air velocity and inches wg for pressure with multiple scales on one meter. There are no internal mechanisms for averaging or calculating air flows (cubic feet per minute).

6.6. Using the Velometer

- 6.6.1. There is no on/off switch. The unit is ready for measuring as soon as the correct probe and accessories are attached.

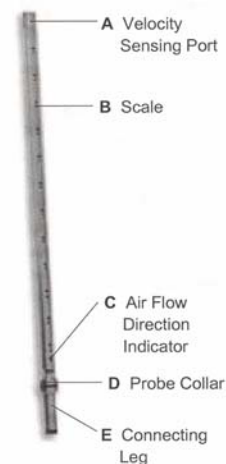
6.7. **Lo-Flow Probe:** Measuring Velocity: low flow applications such as: open areas; hood face velocities; and spray booths.

- 6.7.1. Connect the Lo-Flow Probe directly to the meter. No hose is necessary and the probe only fits on one way.
- 6.7.2. A filter is built in to protect the velometer.
- 6.7.3. Measurements should be in the range of 30-300 fpm and the reading is taken directly from the 0-300 scale on the meter.
- 6.7.4. The instrument should be held so the pointer on the head of the probe points in the direction of air flow. In cases where the direction of air flow is unknown, slowly turn the instrument until the maximum reading is obtained.
- 6.7.5. Record the reading on the appropriate field data collection form and continue with the next measurement.



6.8. **Pitot Probe:** Measuring Velocity: high flows in ductwork and at openings such as slot intakes and grinding wheels.

- 6.8.1. The pitot probe is attached to the appropriate Range Selector.



<p align="center">BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division</p> <p align="center">INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure</p>	<p>NUMBER IH62640</p>
	<p>REVISION Final Rev1</p>
<p>SUBJECT: INSTRUMENT OPERATION</p>	<p>DATE 10/31/05</p>
<p><i>Alnor® 6000-P Velometer Operation</i></p>	<p>PAGE 6 OF 12</p>

6.8.2. The range selector slide switch should be moved to the correct position indicating the maximum velocity anticipated. The knurled knob on the range selector should be in the **“OUT”** position. Note: If the knob does not turn in either direction it is in the out position.

6.8.3. On the bottom of the range selector are two fittings labeled + and -. Remove the red caps and securely attach the tubing to each fitting then the corresponding fitting on the meter body (+ to + ; - to -).

6.8.4. The Probe is now ready to measure air velocity. See appendix 9.2.

6.8.5. Using the range selectors and the multiple scales on the meter, the pitot probe can be used to measure air velocities from 100-10,000 fpm (0.5-50 meters per second).

6.8.6. In case the direction of flow is unknown, rotate the pitot probe slowly to obtain the maximum reading and the arrow on the probe will then indicate the direction of flow.

6.8.7. Directly read the air velocity on the instrument meter using the scale corresponding to the range chosen on the range selector.

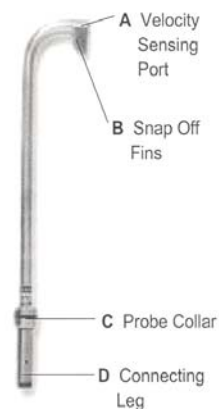
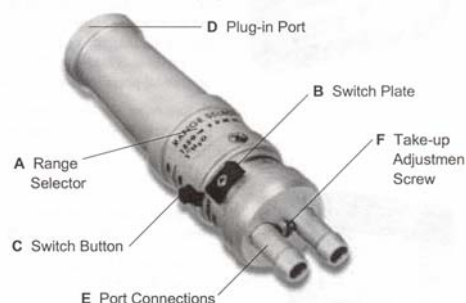
6.8.8. When measuring air flows inside ducts, it is necessary to have a 5/8 inch hole in the side of the ductwork. The pitot probe is inserted with the arrow pointing in the direction of flow inside the duct.

6.8.9. The pitot probe is marked to indicate the insertion depth for readings at various depths. Record both the velocity and the depth for calculating the average air velocity across the duct. See SOP IH62470 “Local Exhaust Ventilation Duct Velocity Traverse Measurements and IH62480 Local Exhaust Ventilation Capture Velocity Measurements.

6.8.10. The maximum working temperature is 700°F (371°C).

6.9. **Diffuser Probe:** Measuring Velocity: high flows such as at HVAC supply/return diffusers and supply openings.

6.9.1. The diffuser probe is attached to the appropriate Range Selector. Push down firmly until the probe collar rests against the range selector.

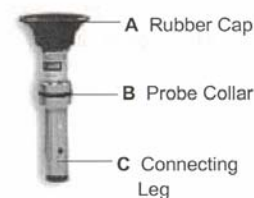


<p align="center">BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division</p> <p align="center">INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure</p>	<p>NUMBER IH62640</p>
	<p>REVISION Final Rev1</p>
<p>SUBJECT: INSTRUMENT OPERATION</p> <p align="center"><i>Alnor® 6000-P Velometer Operation</i></p>	<p>DATE 10/31/05</p> <p>PAGE 7 OF 12</p>

- 6.9.2. The range selector slide switch should be moved to the correct position indicating the maximum velocity anticipated. The knurled knob on the range selector should be in the **“IN”** position. Press the knob into the range selector and turn clockwise to lock in place.
- 6.9.3. On the bottom of the range selector are two fittings labeled + and -. Remove the red caps and securely attach the tubing to each fitting.
- 6.9.4. **For supply diffusers and supply openings**, attach the tubes to the corresponding fitting on the meter body (+ to + ; - to -).
- 6.9.5. **For return diffusers**, attach the tubing in the reverse order (+ on range selector to - on velometer body; and - on Range Selector to + on the velometer body)
- 6.9.6. The Probe is now ready to measure air velocity.
- 6.9.7. Using the range selectors, the diffuser probe can be used to measure air velocities from 100-10,000 fpm (0.5-50 meters per second).
- 6.9.8. The diffuser probe has snap off fins to accurately position the probe vertically, horizontally and radially. See appendix 9.2.
- 6.9.9. When determining diffuser air flows the manufacturer’s “K” factor should be used to correct the readings. Multiply the average velocity reading by the “K” factor to calculate the air flow. $Q=KV$

6.10. Static Pressure Probe: Measuring Static Pressure at the exterior duct surface.

- 6.10.1. There are two static pressure probes. Select the probe and attach to the appropriate Range Selector pushing down firmly until the probe collar rests against the range selector. The 1”wg probe should be attached to the Range Selector, which shows 1”wg.



- 6.10.2. The range selector slide switch should be moved to the left indicating the maximum pressure anticipated. The lower range selector may be used up to a maximum of 1 “wg. The higher range selector may be used for a maximum pressure of 10”wg.
- 6.10.3. The knurled knob on the range selector should be in the **“IN”** position. Press the knob into the range selector and turn clockwise to lock in place.
- 6.10.4. On the bottom of the range selector are two fittings labeled + and -. Remove the red caps and securely attach the tubing to each fitting.
- 6.10.5. **For positive pressures (downstream of the fan)**, attach the tubes to the corresponding fitting on the meter body (+ to + ; - to -).
- 6.10.6. **For negative pressures (upstream of the fan)**, attach the tubing in the reverse

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division	NUMBER IH62640
	REVISION Final Rev1
INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	DATE 10/31/05
	PAGE 8 OF 12
SUBJECT: INSTRUMENT OPERATION	
<i>Alnor® 6000-P Velometer Operation</i>	

order ('+' on range selector to '-' on velometer body; and '-' on Range Selector to '+' on the velometer body)

6.10.7. The Probe is now ready to measure static pressure. See appendix 9.2.

6.10.8. Static pressure readings are read directly from the meter scale on the appropriate scale matching the probe.

6.10.9. **Note: the Alnor® Velometer is not intended for use in corrosive atmospheres.**

6.11. ***Maintenance:***

6.11.1. The *Alnor® Velometer* requires very little maintenance. If any difficulties in the operation of the velometer should develop, return the instrument to the IH lab for necessary maintenance.

7.0 Implementation and Training

7.1 Testing shall be performed only by persons who have demonstrated competence to satisfactorily perform the tests as evidenced by experience and training. The qualification to use this procedure, demonstration of competency, and qualification is documented using Attachment 9.3 Job Performance Measure. All persons must have met the qualification criteria set in IH50300 *BNL IH Program and IH Group Training & Qualification Matrix*.

7.2 Qualification Frequency & Recordkeeping: The supervisor of *Qualified Samplers* is responsible to ensure that the employees remain competent in the operation of this meter.

- Personnel are re-qualified when there is evidence that they do not clearly understand the principles of operation of this meter.
- The re-qualification frequency is 3 years. However, if a person has not used this instrument for a period of over 12 months from the date of last qualification, demonstration of competency to perform this procedure to the satisfaction of the supervisor may be required before sampling commences.
- If significant and substantive changes to the procedure are made, *Qualified Samplers* will be notified of the changes.

8.0 References

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure		NUMBER IH62640
		REVISION Final Rev1
SUBJECT: INSTRUMENT OPERATION		DATE 10/31/05
<i>Alnor[®] 6000-P Velometer Operation</i>		PAGE 9 OF 12

8.1 Alnor Operating Instructions for the Series 6000-P Velometer.

9.0 Attachments

- 9.1 Photograph of meter and accessories
- 9.2 *Alnor[®] Velometer General Set Ups*
- 9.3 *Job Performance Measure*

10.0 Documentation

Document Development and Revision Control Tracking		
Prepared By: (signature/date on file) J. Peters 4/26/05 Certified Industrial Hygienist	Reviewed By / Date: (signature/date on file) R. Selvey 4/28/05 Certified Industrial Hygienist	Approved By / Date: (signature/date on file) R. Selvey 04/28/05 Industrial Hygienist Group Leader
ESH Coordinator/ Date: <i>none</i>	Work Coordinator/ Date: <i>none</i>	SHSD Manager / Date <i>none</i>
QA Representative / Date: <i>none</i>	Training Coordinator / Date: <i>none</i>	Filing Code: IH52.05
Facility Support Rep. / Date: <i>none</i>	Environ. Compliance Rep. / Date: <i>none</i>	Effective Date: 04/30/05
ISM Review - Hazard Categorization <input type="checkbox"/> High <input type="checkbox"/> Moderate <input checked="" type="checkbox"/> Low/Skill of the craft	Validation: <input type="checkbox"/> Formal Walkthrough <input checked="" type="checkbox"/> Desk Top Review <input type="checkbox"/> SME Review Name / Date:	Implementation: Training Completed: Tracked in BTMS Procedure posted on Web: 10/31/05 Hard Copy files updated: 10/31/05

Revision Log		
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input checked="" type="checkbox"/> Periodic review <input checked="" type="checkbox"/> Clarify/enhance procedural controls		
Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above		
Section/page and Description of change: Revised Section 7 training requirements. Updated Section 10 to new format.		
(signature/date on file) R. Selvey 10/31/05 SME Reviewer/Date:	Reviewer/Date:	Reviewer/Date:

The only official copy is on-line at the SHSD IH Group website.
Before using a printed copy, verify that it is current by checking the document issue date on the website.

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH62640
	REVISION Final Rev1
SUBJECT: INSTRUMENT OPERATION	DATE 10/31/05
<i>Alnor® 6000-P Velometer Operation</i>	PAGE 10 OF 12

Attachment 9.1

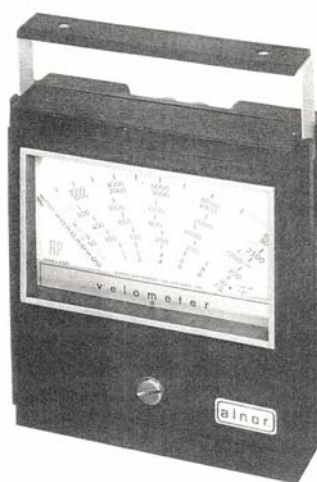
Alnor® Velometer Meter and Accessories



PITOT
PROBE



DIFFUSER
PROBE



SERIES 6000
VELOMETER



LO-FLO
PROBE



STATIC
PRESSURE PROBE

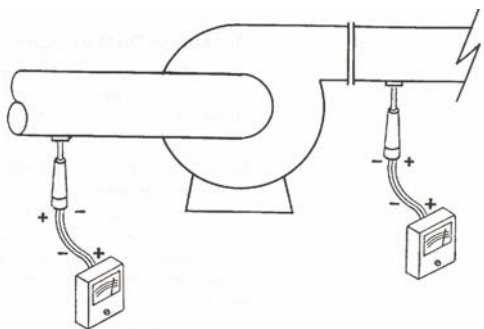


RANGE
SELECTOR

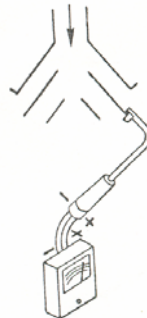
BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER IH62640
	REVISION Final Rev1
SUBJECT: INSTRUMENT OPERATION	DATE 10/31/05
<i>Alnor® 6000-P Velometer Operation</i>	PAGE 11 OF 12

Attachment 9.2

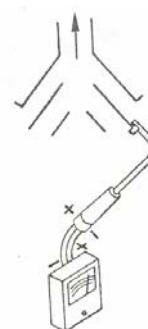
General Velometer Set Ups



Measuring Static Pressure

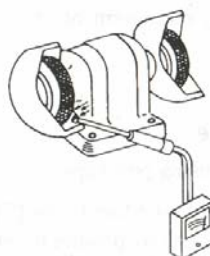


Supply

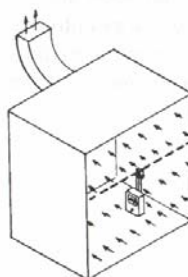


Return

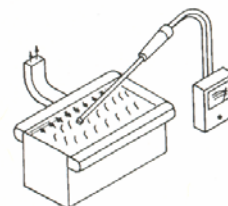
Measuring Diffuser Air Velocity



**Measuring
Grinding/Buffering
Wheel Velocity**



**Measuring Hood Face
Velocity**



**Measuring Slot
Velocity**

Operation of the Alnor Velometer

Job Performance Measure (JPM) Completion Certificate

Candidate's Name	Life Number:
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Knowledge of the Principles of Exhaust Ventilation Investigations

Criteria	Qualifying Standard	Unsatisfactory	Recovered	Satisfactory
Hazard Analysis	Understands the need to perform a hazard analysis of the sampling area and potential exposure to the sampler.			
Personal Protective Equipment	Understands the need to be aware of potential exposures to the sampler and how to determine appropriate PPE.			
Sampling Protocol	Understands the ventilation system design parameters and logic necessary to appropriately select sampling locations for accurate measurements.			
Analysis of data	Understands the need to perform analysis on the sampling data to assess the effectiveness of the ventilation system and potential exposure to the sampler, worker, public and environment. Also, to recommend corrective actions as necessary.			

Practical Skill Evaluation: Demonstration of Sampling Methodology

Criteria	Qualifying Performance Standard	Unsatisfactory	Recovered	Satisfactory
Sampling Equipment	Knows where equipment needed for the procedure is located and how to properly sign it out.			
Meter Operation	Demonstrates the proper way to set up, turn on and use the meter.			
Record forms	Shows how to correctly and completely fill all forms associated with this SOP.			
Data Analysis	Knows the correct criteria and operating ranges. Shows how to correctly analyze data and compare to acceptable criteria.			
Report preparation and distribution	Knows how to document the assessment and the correct distribution.			

Employee: I accept the responsibility for performing this task as demonstrated within this JPM and the corresponding SOP.

Candidate Signature:	Date:
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Evaluator: I certify the candidate has satisfactorily performed each of the above listed steps and is capable of performing the task unsupervised.

Evaluator Signature:	Date:
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